

BAB V

NERACA PANAS

Kapasitas Produksi	: 100.000 Ton/Tahun
Operasi Pabrik	: 300 Hari/Tahun
Basis	: 1 jam operasi
Satuan	: Kilo Joule (kJ)
Temperatur Referensi	: 25°C

5.1. Tunnel Dryer (TD-01)

Komponen	Input (kJ/jam)	Output (kJ/jam)
Q ₄	2.569.600,1968	-
Q ₆	-	1.047.886,7277
Q ₇	-	39.021.558,8039
Q _{steam in}	876.972.256,5409	-
Q _{steam out}	-	839.472.411,2061
Total	879.541.856,7377	879.541.856,7377

5.2. Gasifier (G-01)

Komponen	Input (kJ/jam)	Output (kJ/jam)
Q ₁₀	39.021.558,8039	-
Q ₁₇	162.597.604,0925	-
Q ₁₈	-	201.881.507,4092
Q _{reaksi}	-	-262.344,5128
Total	201.619.162,8964	201.619.162,8964

5.3. Tar Removal (TR-01)

Komponen	Masuk (kJ/jam)	Panas Keluar (kJ/jam)
Q ₂₀	200.697.888,2361	-
Q ₂₁	-	201.822.899,5737
Q _r	-	-54.763,8943
Q	-	-1.070.247,4432
Total	200.697.888,2361	200.697.888,2361

5.4. Waste Heat Boiler (WHB-01)

Komponen	Masuk (kJ/jam)	Panas Keluar (kJ/jam)
Q_{21}	201.822.899,5737	-
Q_{air}	1.076.580,1540	-
Q_{22}	-	49.753.301,7335
Q_{steam}	-	153.146.177,9941
Total	202.899.479,7277	202.899.479,7277

5.5. Spray Tower (ST-01)

Komponen	Input (kJ/jam)	Output (kJ/jam)
Q_{22}	49.753.301,7335	-
Q_{25}	-	5.627.335,7917
Q_{23}	13.100.526,7909	-
Q_{24}	-	57.226.492,7327
$Q_{kondensasi}$	30.263.612,7648	-
Total	62.853.828,5244	62.853.828,5244

5.6. Heater (H-01)

Komponen	Input (kJ/jam)	Output (kJ/jam)
Q_{28}	20.905.650,5790	-
Q_{29}	-	58.538.183,9165
$Q_{steam\ in}$	73.655.877,5938	-
$Q_{steam\ out}$	-	36.023.344,2563
Total	94.561.528,1728	94.561.528,1728

5.7. Caustic Scrubber (CS-01)

Komponen	Input (kJ/jam)	Output (kJ/jam)
Q_{25}	5.627.335,7917	-
Q_{32}	-	757.480,2486
Q_{29}	58.538.183,9165	-
Q_{30}	-	63.462.987,2524
Q_{reaksi}	-	-54.947,7928
Total	64.165.519,7082	64.165.519,7082

5.8. Heat Exchanger (HE-01)

Komponen	Input (kJ/jam)	Output (kJ/jam)
Q ₂₅	2.511.304,8765	-
Q ₂₆	-	214.306,3408
Q ₇₆	757.480,2486	-
Q ₇₇	-	3.011.880,1975
Total	3.268.785,1252	3.268.785,1252

5.9. Heat Exchanger (HE-02)

Komponen	Input (kJ/jam)	Output (kJ/jam)
Q ₂₆	43.670.883,4154	-
Q ₂₇	-	33.047.090,7221
Q ₇₉	3.011.880,1975	-
Q ₈₀	-	13.635.672,8911
Total	46.682.763,6129	46.682.763,6129

5.10. Heater (H-02)

Komponen	Input (kJ/jam)	Output (kJ/jam)
Q ₂₇	13.635.672,8911	-
Q ₂₈	-	36.960.929,8804
Q _{steam in}	45.653.112,3813	-
Q _{steam out}	-	22.327.855,3920
Total	59.288.785,2724	59.288.785,2724

5.11. Steam Methane Reformer (SMR-01)

Komponen	Input (kJ/jam)	Output (kJ/jam)
Q ₂₈	36.960.929,8804	-
Q ₃₂	233.865,9418	-
Q ₃₄	-	37.209.329,5417
Q _{reaksi}	-	-14.533,7195
Total	37.194.795,8222	37.194.795,8222

5.12. Heat Exchanger (HE-03)

Komponen	Input (kJ/jam)	Output (kJ/jam)
Q ₃₅	37.209.329,5417	-
Q ₃₆	-	19.214.777,4435
Q ₃₉	2.251.185,3105	-
Q ₄₀	-	20.245.737,4087
Total	39.460.514,8522	39.460.514,8522

5.13. Heat Exchanger (HE-04)

Komponen	Input (kJ/jam)	Output (kJ/jam)
Q ₃₆	18.884.408,3416	-
Q ₃₇	-	6.342.869,6508
Q ₂₁	8.364.111,8882	-
Q ₂₂	-	20.905.650,5790
Total	27.248.520,2298	27.248.520,2298

5.14. Absorber (AB-01)

Komponen	Input (kJ/jam)	Output (kJ/jam)
Q ₃₇	6.342.869,6508	-
Q ₄₀	20.245.737,4087	-
Q ₅₀	-	5.884.284,7114
Q ₄₁	-	20.704.322,3481
Q _{reaksi}	-	-20.165.589,0898
Total	26.588.607,0595	26.588.607,0595

5.15. Heater (H-03)

Komponen	Input (kJ/jam)	Output (kJ/jam)
Q ₄₁	20.704.322,3481	-
Q ₄₂	-	47.518.122,6932
Q _{steam in}	52.481.026,9437	-
Q _{steam out}	-	25.667.226,5986
Total	73.185.349,2918	73.185.349,2918

5.16. Stripper (ST-01)

Komponen	Input (kJ/jam)	Output (kJ/jam)
Q ₄₂	47.518.122,6932	-
Q ₄₆	-	43.670.883,4154
Q ₄₃	-	1.194.820,4635
Q _{reaksi}	-	2.652.418,8142
Total	47.518.122,6932	47.518.122,6932

5.17. Cooler (CO-01)

Komponen	Input (kJ/jam)	Output (kJ/jam)
Q ₄₈	33.050.637,9761	-
Q ₄₉	-	2.376.943,8751
Q _{cw in}	-22.752.766,9802	-
Q _{cw out}	-	7.920.927,1208
Total	10.297.870,9959	10.297.870,9959

5.18. Cooler (CO-02)

Komponen	Input (kJ/jam)	Output (kJ/jam)
Q ₄₄	1.194.820,4635	-
Q ₄₅	-	62.196,1418
Q _{cw in}	-840.144,5611	-
Q _{cw out}	-	292.479,7606
Total	354.675,9024	354.675,9024

5.19. Heater (H-04)

Komponen	Input (kJ/jam)	Output (kJ/jam)
Q ₅₂	2.950.129,7464	-
Q ₅₃	-	12.904.531,7190
Q _{steam in}	19.483.147,9092	-
Q _{steam out}	-	9.528.745,9366
Total	22.433.277,6556	22.433.277,6556

5.20. Reaktor Metanol (MR-01)

Komponen	Input (kJ/jam)	Output (kJ/jam)
Q ₅₃	12.904.531,7190	-
Q ₅₄	-	10.160.821,3733
Q _{reaksi}	-	2.752.180,8883
Q	-	-8.470,5426
Total	12.904.531,7190	12.904.531,7190

5.21. Heater (H-05)

Komponen	Input (kJ/jam)	Output (kJ/jam)
Q ₅₇	2.950.129,7464	-
Q ₅₈	-	15.184.704,7600
Q _{steam in}	23.945.992,4617	-
Q _{steam out}	-	11.711.417,4481
Total	26.896.122,2081	26.896.122,2081

5.22. Heater (H-06)

Komponen	Input (kJ/jam)	Output (kJ/jam)
Q ₅₄	10.160.821,3733	-
Q ₅₅	-	12.069.243,4456
Q _{steam in}	3.735.238,9035	-
Q _{steam out}	-	1.826.816,8311
Total	13.896.060,2768	13.896.060,2768

5.23. Reaktor Etanol (ER-01)

Komponen	Input (kJ/jam)	Output (kJ/jam)
Q ₅₅	12.069.243,4456	-
Q ₅₈	15.184.704,7600	-
Q	-	-13.110.684,1523
Q ₅₉	-	40.389.762,2812
Q _{reaksi}	-	-25.129,9233
Total	27.253.948,2056	27.253.948,2056

5.24. Waste Heat Boiler (WHB-02)

Komponen	Input (kJ/jam)	Output (kJ/jam)
Q_{59}	40.389.762,2812	-
Q_{air}	179.716,4173	-
Q_{60}	-	15.004.375,7867
Q_{steam}	-	25.565.102,9118
Total	40.569.478,6985	40.569.478,6985

5.25. Parsial Condensor (PC-01)

Komponen	Input (kJ/jam)	Output (kJ/jam)
Q_{60}	15.004.375,7867	-
Q_{61}	-	9.038.164,9590
$Q_{cw \text{ in}}$	-27.432.721,8333	-
$Q_{cw \text{ out}}$	-	9.428.616,5626
$Q_{kondensasi}$	30.895.127,5682	-
Total	18.466.781,5216	18.466.781,5216

5.26. Heater (H-07)

Komponen	Input (kJ/jam)	Output (kJ/jam)
Q_{65}	3.361.435,3442	-
Q_{66}	-	4.722.465,2128
$Q_{steam \text{ in}}$	2.663.861,3060	-
$Q_{steam \text{ out}}$	-	1.302.831,4374
Total	6.025.296,6502	6.025.296,6502

5.27. Kolom Destilasi (KD-01)

Komponen	Input (kJ/jam)	Output (kJ/jam)
Q_{66}	3.407.655,1004	-
Q_{71}	-	2.511.304,8765
Q_{67}	-	2.138.490,4092
Q_{laten}	15.983.934,8505	-
$Q_{kondensasi}$	-	14.741.794,6652
Total	19.391.589,9509	19.391.589,9509

5.28. Total Condensor (TC-01)

Komponen	Input (kJ/jam)	Output (kJ/jam)
Q_{74}	5.466.279,6247	-
Q_{72}	-	7.242.802,9973
Q_{71}	-	2.511.304,8765
Q_{laten}	57.302.573,8953	-
$Q_{\text{cw in}}$	13.270.233,2992	-
$Q_{\text{cw out}}$	-	66.284.978,9453
Total	76.039.086,8192	76.039.086,8192

5.29. Reboiler (RB-01)

Komponen	Input (kJ/jam)	Output (kJ/jam)
Q_{67}	19.590.476,8983	-
Q_{70}	-	7.851.348,7127
Q_{68}	-	2.138.490,4092
Q_{latem}	-	149.200.953,4452
$Q_{\text{steam in}}$	273.231.240,3935	-
$Q_{\text{steam out}}$	-	133.630.924,7248
Total	292.821.717,2918	292.821.717,2918

5.30. Cooler (CO-03)

Komponen	Input (kJ/jam)	Output (kJ/jam)
Q	63.462.987,2524	-
Q	-	19.769.311,1968
$Q_{\text{cw in}}$	-32.410.573,9115	-
$Q_{\text{cw out}}$	-	11.283.102,1440
Total	31.052.413,3408	31.052.413,3408